

**OSART Good Practices**  
**CHEMISTRY**  
**Chemical Surveillance Programme**

**Belleville, France**

Mission Date; 9-26 October, 2000

Application of a Laboratory Information and Management System called MERLIN for the diverse jobs of a laboratory from taking samples to data evaluation. With the MERLIN application the plant has:

- easily integrated corporate chemistry specifications
  - adjusted them to plant specifics, setting of more restrictive thresholds, setting specifications per type, date and frequency
  - adjusted them to the laboratory organization and job rotation system
- Custom made work schedules (including analysis, samples and readings), based on workstation
  - scheduled analyses to be carried out
  - unscheduled requests from operations
  - keyed in, check and validate data
  - some considerable time thanks to the use of remote computer terminal for readings
- Improved its trend analysis process
  - easy creation of charts, reports and curves for any chemical data
  - instant access to older plant data (historical records since commissioning)
- Improved its QA system
  - track measuring instruments
  - enhanced first level check: display of chemical specifications when keying in results, display of 10 latest values, red marking of any deviation
  - display and use on-line instrument data (control charts)
  - enhanced supervision based on the existence of lines of defense: deviation report issued every night and immediate treatment by foremen
  - one single computer application for all section activities
- An integrated experience feedback system to corporate level
  - efficient communication with corporate level: improved corporate experience feedback with instant display the data relating to all French plants in real time

A risk analysis was carried out jointly with the plant computer deputy prior to the actual implementation of MERLIN. This analysis list risk of and barriers to any deficiency in the software.

MERLIN has a custom made work schedule for the plant and each work station. The data input is checked with the chemistry specifications and validated or red marked for any deviation. With MERLIN the plant has a quick tool to created any kind of reports or trends with instant access to historical records since commissioning. Furthermore, MERLIN has an integrated quality assurance system and experience feedback system to corporate level. Operations and Safety & Quality departments may display MERLIN data after they have been validated by the chemistry section.

The MERLIN system is one single tool for all chemistry jobs.

## Paks 1/4, Hungary

Mission Date; 8-25 October, 2001

On-line analyzers are used to ensure that only demineralized water of accepted quality will be used. The demineralized water for the plant is produced on the make up water plant. In the common line from this plant to the storage tanks are an analyzer for silicate and a conductivity meter installed. These two analyzers control an isolation valve and it will close if a pre-set value for either one analyzer is exceeded. By this procedure it is ensured that demineralized water of proper quality in any situation is fed to the storage tanks. The valve can only be opened when receiving water that fulfil the requirements. The fact that such a system is installed is above the general standard applied on power plants.

## Angra 2, Brazil

Mission Date; 12-31 October, 2002

The liquid radioactive waste storage and treatment process is well controlled by the Control System for Liquid Waste Storage and Processing (SISREJ) computer programme.

The programme was developed with the aim to assure prompt and effective interaction between waste system operator, chemistry division managers and supervisors, control room operator and also to give information about waste system via the computer network. The safety and integrity of the programme is warranted by restricted access.

By using different tables and corresponding files in the programme the whole storage and treatment process (the volume and storage place of liquid waste, the chemical and radiochemical parameters, necessary treatments, and the authorization for release) can easily be followed, registered and controlled by authorized personnel.

Considering laboratory-related risks: risk analysis

A very effective and systematic risk analysis process is established in the chemistry section.

A risk analysis is formalized in all laboratory procedures using a pre-established pattern (risk identification per field and associated defensive measures). For specific activities (such as sipping tests on the fuel assemblies, sampling from safety injection accumulators, calibration of the oxygen-meter on the gaseous effluent treatment system, among others) that have been listed in a daily activities management form in the Technical department (ST), a quality plan is drafted with the incorporation of the risk analysis.

These risk analyses take into account the external experience feedback as well as internal experience feedback provided by the post-job briefings. The risks detected are incorporated and reminded during the pre-job briefing associated to the corresponding action.

In addition, the department has set up the use of Files on Safety or Industrial Safety Related Risks (FIRS). These FIRS enable low level events to be reported by plant personnel and are added to the pre-job folders for internal Experience Feedback purposes. This analysis is undertaken by plant personnel who make the findings. The team then collectively analyses the experience feedback and proposes corrective actions. These are analysed and validated by the department management team (EDS). The decision is then communicated to the team and taken into account for pre-job Experience Feedback.

As a result, issues are collected and analysed very widely and rapidly, and reports are disseminated to all staff in a timely manner.

Laboratory Experience Feedback process is incorporated into the daily management loop for an activity.

The reported experience feedback is discussed weekly during a lab team meeting and is added to the pre-job preparation folder where the experience feedback is classified into different areas. After carrying out the activities based on the analysis, discussion takes place again. This cycle rotates continuously.

As a result, a number of reports (external and internal) are drafted and analysed by the team, and are added to the experience feedback folders (approximately 70 reports/year).

## Qinshan3, China

Mission Date; 5-24 May, 2005

inter-laboratories comparison and peer check with other Qinshan Nuclear Power plant sites.

To share the technology resources in chemistry area of in-land NPPs, and to improve the level of plant chemistry management together, TQNPC chemistry department sponsored the civilian chemistry association of the in-service NPPs in the mainland of China, which was founded in 2004. Up to now, the main body of this association is Qinshan Nuclear Power Base including Qinshan Phase I, Qinshan Phase II and Qinshan Phase III. Daya Bay Nuclear Power Plant and Ling Ao Nuclear Power Plant also take part in.

The mainly activities of this association includes:

-An annual conference hosted by one of the member plant, which will also give the topics for the conference according to the chemistry concerns of their plant.

-Peer check of the member plants: The third Qinshan nuclear power plant had invited specialists of chemistry area from Qinshan Phase I and Qinshan Phase II to assess chemistry activities in Qinshan Phase III on November 2004. The specialists had gave out some good suggestions through their review of chemistry area in Qinshan Phase III.

Inter-lab Comparison in Qinshan Nuclear power plant sites: The analysis results of Tritium, raw water, impurities from SG blow down and blind sample have been compared among the labs from Qinshan Phase I, Phase II and Phase III. The results showed the deviation of the data from the three plants was less than the limit defined in the QC procedures, and the deviation of the data from the different technicians in TQNPC lab was also less than the limit defined in the QC procedures.

## Blayais, France

Mission Date; 2-19 May, 2005

The quality assurance system for the laboratories and continuous measurements is set to plan, perform, track and evaluate the results for both the laboratories and the on-line instruments. The quality assurance system also ensures a proper control for the chemical parameters during operations.

This quality assurance system is supported by software:

-MERLIN to guarantee that the specifications are respected, to programme the analyses, to key in, control and archive the results, to follow the evolution of measurements.

-CAOLIN to control and correlate several chemical parameters for cross checking (e.g. correlation between continuous cationic conductivity measurement and laboratory measurement of anions).

Analytical procedures for instruments are excellently prepared. Extensive tests are performed to quantify and demonstrate errors, sensitivity, reliability and stability of methods used.

Control instruments charts are designed to follow their metrological state. The validation process of measurements (including trend analysis) allows to evaluate the measurement method of chemical parameters in real time.

For setting traceability of measurements according to national reference standards, all the laboratories of the chemistry department are involved at the national level in intercomparison tests with CEIDRE and LNHB. Moreover, the environment laboratory is involved at the national level in intercomparison tests with the IRSN (Institute of Radioprotection and of Nuclear Safety).

Independent standards are used for laboratory and continuous measurement to avoid systematically mistakes. There is one standard for calibration, another for working standard during measurement and a third one for independent control.

## Brunswick, USA

Mission Date; 9-26 May, 2005

The Environmental and Chemistry organization has access to the operational process computer and the Chemistry Data Management System via pager. This data can be viewed online. The daily "Environmental and Chemistry Status Report" is generated automatically, thus excluding human errors in data transfer. The report is approved by E&C and distributed in the daily morning meeting. All data can be combined with limiting values and, if these values are reached, sent via radio to the pager of the E&C laboratory supervisor. It is also possible to send all the values or a selection of the values periodically to the pager. This significantly reduces action times of E&C.

## Borssele, Netherland

Mission Date; 8 Nov.-7 Dec., 2005

A supplementary criteria evaluation of international comparison results on waste water measurements allows the plant to better assess and improve the performance of laboratory measurements.

NPP Borssele participates yearly in international comparisons on radio waste water measurements with good results, but the plant was looking to improve the way to establish his performance and to compare with other laboratories, with higher performance. Not only the deviation from the real value is used, but a supplementary criterion is introduced: the number of participants with a smaller deviation. The result is good when the absolute value is less than 10% and also less than 50% of the participants with a smaller deviation. The results are not acceptable when deviation is more than 10% (respectively 15%) and the number of participants with a smaller deviation is more than 75% (respectively 50%). The criterion is combined in a matrix and is used as a stimulant for the plant to improve the results.

As the results of using of evaluation criteria, and the benchmarking with other inter-comparison participants, the sample preparations and the counting methods were improved and the number of deviations from the real value has decreased over time.

#### Analysis of ion exchange resins

The plant has a very good system for the control of qualitative parameters of ionex materials used at the power plant. Samples are regularly taken from systems, including the primary and secondary systems, for evaluation and identification of degrading ionex material performance.

Ionex materials in the primary circuit are analysed following a problem with the quality of the output medium or some other problem (increase of pressure difference, shortening the working cycle, etc.)

The power plant performs the following analyses:

1. - optical aspects (under microscope) in the first place in the condition "as is", subsequently after washing and subsequently after regeneration, possibly after specially prepared cleaning procedure (sediments, oils, greases, corrosion products, etc.)
2. - total exchange capacity - volume and mass (in eq/l, or eq/ kg)
3. - content of water - MHC (moisture holding capacity) (in mass %)
4. - the content of dry solids (in mass %)

This analyses enables the plant to determine what happened with a particular ionex based on a comparison of this data with the same parameters of a new ionex (stored samples are used in this time).

This practice enables the power plant to evaluate the real time current condition of an ionex and identify possible violations of operational conditions under which ion resins were working. The power plant closely cooperates in solving of problems in the area of cleaning abilities of ionex materials with producers of ionex materials. This practice also enables NPP management to monitor the current state, predict the real lifetime of ion exchange resins, and facilitates better planning of exchange cycles of these ion exchange resins for individual purification stations on the primary and secondary circuit. Based on this program, the NPP was able to extend the cycle of the primary circuit coolant ionex resin from one to two years.

## South Ukraine3, Ukraine

Mission Date; 9-25 Oct., 2006

### On-line chemistry data processing system

The plant installed an effective on-line Chemistry Data Processing System (DAPS) that ensures automatic correction of key parameters in the primary circuit as molar concentration alkaline metals in dependence of boric acid.

The functions of the system for data acquisition and processing are as follows:

- acquisition of important chemistry and process parameters, their processing, storage and display under all operation modes;
- comparison of the measured parameters with standard values;
- generation of alarms when the set-points are exceeded;
- diagnosis analysis by identifying causes of deviations in the chemistry control parameters; and
- suggestion of generation to the plant operators for chemistry process optimization on base chemistry algorithms.

This system enables maintaining the equilibrium alkaline metals related to the boric acid that contributes to stabilizing chemistry regimes of water reactor and controlling of corrosion products transport in the primary circuit. For example:

- corrosion products in the primary circuit decreased about 15% and
- the surface dose rates of steam generator collectors decreased about 20%.

## St. Laurent, France

Mission Date; 27 Nov. - 14 Dec., 2006

There is an applied management system to project liquid RW effluent releases together with close monitoring of effluent production in nuclear areas. The effluent control laboratory has on-line river flow data available, as well as analysis results in electronic form to be able to project concentrations in the river. As soon as the flow rate of the Loire falls below 60m<sup>3</sup>/s, the site of Saint Laurent takes charge of the coordination of tritium releases from the tanks of the four NPP sites located over a distance of about 200 km along the Loire, that is altogether 18 liquid radwaste monitoring and discharge system tanks. Saint Laurent collects the relevant information from the other sites and draws up an overall weekly schedule for releases to come, taking account of transit time. This schedule is submitted to the other sites for approval, then sent to the regulator, every week. The sensitive environment of a natural Loire reserve remains protected respecting regulatory limit for the concentration.

### Chemical cleaning for steam generator

From 2000 Balakovo NPP started implementation of chemical cleaning technology with application of acetate ammonia and EDTA solutions for Steam Generator cleaning from dense crud consisting of iron and copper oxides. Chemical cleaning is implemented in three stages, .:

- During the first stage («cold») copper compounds are removed by means of acetate ammonia solution and ammonia solution with pH=10,2 at 40 C. Compressed air, as oxidizing agent, is supplied for solution mixing. The time dedicated to this operation should be about 5 to 6 hours.
- During the second stage («hot») EDTA solution and acetate ammonia solution at 95-98 C with pH=5,0-5,5 are used for removal of crud, consisting of iron oxides. Solution is mixed by steam. The time dedicated to this operation should be about 5 to 6 hours.
- During the third stage («cold») ammonia acetate and ammonia solution with pH=10,0 and at temperature 40-50 C are used for post treatment against copper residue and passivation of cleaned surface. The time dedicated to this operation should be about 5 to 6 hours.

The results of chemical cleaning based on this technology demonstrated high efficiency enabling at the first stage of chemical cleaning to transform copper compound as well as metal copper in the form of copper ammonium complex, to loosen crud and at the second stage to transform iron oxides into the soluble complex with EDTA and remove it from steam generators.

This method of cleaning steam generators has been performed thirty six (36) times at Balakovo NPP from 2000 to 2008 using this technology.

### Standards for laboratory management

In order to improve the quality of measurements, Rivne NPP has implemented a procedure for the preparation of reference samples (standard specimen) that are produced by the personnel of the Group dedicated for the preparation of chemical solutions in the Water Chemistry Laboratory.

#### Implementation milestones:

2005 - Purchase of analytical equipment - water purification facilities of 1st class, the scale of 1st class with accuracy AX-205 type;

2006-2007 - Refinement of the procedure for sample preparation and establishment of true values of the reference samples according to the document "State Measuring System (GIS) Certified mixtures. General requirements to the development" RMG-60-2003;

2008 - Development of "Provisions on laboratory control of the quality of measurements in the Water Chemistry Laboratory of Chemistry Department" #171-7-P-KhC and "Methodology for standard sample preparation" #171-09-MVI-VRKhL-KhC;

2008 - Regular training sessions on the topic "Technology of preparation of reference solutions and standard specimen" for dedicated staff.

Using chemical salts, the Group dedicated for the preparation of chemical solutions in the Water Chemistry Laboratory prepares standards for other Chemistry Department laboratories.

The nomenclature of standard reference samples for solutions and parameters are controlled and developed based on the norms of the Water Chemistry Laboratory, i.e. laboratory control, calibration of measuring instruments, etc.

The personnel of the Group preparing chemical solutions have the required knowledge, skills and abilities for the preparation of high quality reference samples (standard specimen).

The required accuracy, correctness and effectiveness of the measurement quality system are achieved and standards are distributed for all analytical groups of the Water Chemistry Laboratory.

Timely calibration of all measuring instruments of the Water Chemistry Laboratory is ensured.